PATENT ABSTRACTS OF JAPAN

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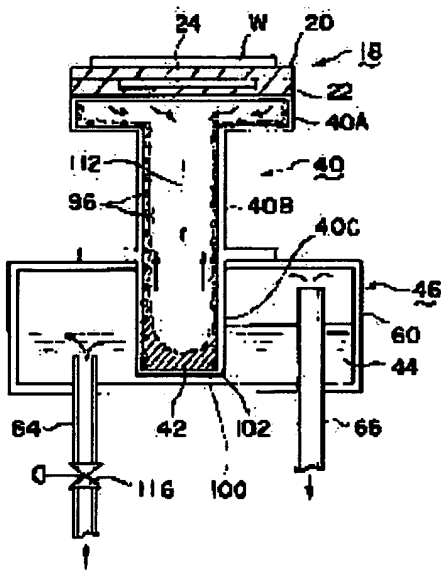
(54) PLACING DEVICE FOR OBJECT TO BE PROCESSED

(57)Abstract:
PURPOSE: To efficiently cool an object to be processed by bringing the object into contact with one end of a heat pipe filled with a working fluid so as to transfer the heat of the object to the other end of the heat pipe and, at the same time, the other end of the peat pipe into contact with the coolant of a cooling means.
CONSTITUTION: A heat pipe 40 filled with a working fluid 42, such as FreonR, etc., is provided below the lower susceptor 22 of a stage 18 in a processing chamber in a state where the pipe 40 is brought into face-contact with the susceptor 22 and, at the same time, the lower end section of the pipe 40 is inserted into a cleaning jacket 46 so as to constitute a condensing section 40C. While a waver W is heated during an etching process, the heat of the wafer W is transferred to the evaporating section 40a of the pipe 40 through an upper susceptor 20 and the lower susceptor 22. The fluid 42 in the pipe 40 ascends along a wick 96 by a capillary phenomenon and reaches the section 40A. In the section 40a, the fluid 42 vaporizes upon receiving the heat from the susceptor 22 and flows down to the section 40C as a vapor flow 112. In the section 40C, the vapor is liquefied.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] Installation equipment of the processed object characterized by having been contacted by the other end of the installation base in which a processed object is laid, the heat pipe with which it filled up with the working fluid to contact an end on said installation base and carry the warm temperature of said processed object to the interior at the other end, and said heat pipe, and having a cooling means to have the refrigerant which discharges said carried warm temperature.
[Claim 2] Installation equipment of the processed object according to claim 1 characterized by forming a RF insulating member between said installation bases and said cooling means.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the installation equipment of a processed object.
[0002]
[Description of the Prior Art] The plasma etching system which generally etches into the bottom of reduced pressure the wafer which is a processed object as equipment which performs some processes of a semi-conductor production process using the activity plasma is known. Although this kind of etching is the approach of processing a pattern perpendicular to a mask when the ion in the gas plasma carries out incidence at right angles to a wafer front face, since the radical which carries out incidence to a wafer from arbitration also exists in the gas plasma, it may produce side etching. In order to prevent this side etching, in order to optimize etching conditions, selection of etching gas, selection of mixed gas, low-gas-pressure force-ization, etc. have been performed until now.
[0003] However, by these approaches, since it is based on reduction of the number of radicals, and the increment in ion energy, processing takes long duration or problems, like the process which an etch rate falls, and a selection ratio with a photoresist falls, and forms a dry etching-proof nature mask is needed have occurred. That is, it was difficult to fulfill a high anisotropy, a high etch rate, and high selectivity to coincidence, and it had become etching at the sacrifice of either. Under such a situation, the low-temperature dry etching which performs etching processing where wafer temperature is maintained at low temperature appeared. In this kind of low-temperature dry etching, the cooling means is formed in the installation equipment which carries out installation immobilization of the processed object, and the laid wafer is cooled. Although the laying temperature of wafer cooling is -60 degrees C - about -100 degrees C in the present condition, low-temperature-treatment-ization of a wafer progressing increasingly from now on, for example, setting it as no less than -150 degrees C low temperature is also expected. In order to perform such high cooling, it is necessary to use the liquid nitrogen which can maintain -196-degree C low temperature as a cooling medium also in consideration of a heat transfer loss.
[0004]
[Problem(s) to be Solved by the Invention] By the way, although it is common to constitute so that the hold section which holds a cooling medium down the installation base of a wafer may be prepared and a wafer may be cooled by future cold energy when using liquid nitrogen etc. as a cooling medium Since it is necessary to establish the pusher pin and various kinds of system of measurement which appear in the vertical direction of an installation base frequently when performing the insulating material for severing the effect of a RF, delivery of a wafer, etc., the lower part of the installation base of a wafer must be made to estrange the hold section of the above-mentioned cooling medium from an installation base, and it must be installed in it. In this case, although the thermally conductive good ingredient was made to intervene between an installation base and the hold section of a cooling medium comparatively, it not only cannot fully cool the wafer

itself, but the thermal resistance of the above-mentioned insulating material etc. was comparatively large, and it still had the improving point that the temperature control nature of the wafer itself was not enough, either. Furthermore, since the above inclusion existed, the radial-temperature-uniformity nature of a wafer also had the improving point of not being good. This invention is originated paying attention to the above troubles that this should be solved effectively. The purpose of this invention is by using a heat pipe to offer the installation equipment of the processed object which raised heat-conducting characteristic.

[0005]

[Means for Solving the Problem] In order to solve the above-mentioned trouble, this invention is contacted by the other end of the installation base in which a processed object is laid, the heat pipe with which it filled up with the working fluid to contact an end on said installation base and carry the warm temperature of said processed object to the interior at the other end, and said heat pipe, and is equipped with a cooling means to have the refrigerant which discharges said carried warm temperature.

[0006]

[Function] Since the other end of this heat pipe is touched by the refrigerant of a cooling means while the processed object by which installation immobilization was carried out on the installation base is contacted by the end of the heat pipe which filled up the interior with the working fluid, since this invention was constituted as mentioned above, the warm temperature of the above-mentioned processed object is taken by evaporation of a working fluid, this is cooled, and it is cooled with the refrigerant of the other end, and the steam of a working fluid is re-condensed, and serves as a liquid again. Thus, when the working fluid in a heat pipe repeats and circulates through evaporation and condensation, the warm temperature of a processed object will be carried to a cooling means side, and will cool a processed object efficiently.

[0007]

[Example] Below, one example of the installation equipment of the processed object concerning this invention is explained in full detail based on an accompanying drawing. The sectional view showing the plasma etching system with which drawing 1 applied the installation equipment of the processed object of this invention, and drawing 2 are the sectional views showing the installation equipment of the processed object in the plasma-etching installation shown in drawing 1 . In this example, the case where the installation equipment of a processed object is applied to a plasma etching system is explained.

[0008] First, the wafer loading port and wafer unloading port (not shown) of a plasma etching system 2 are connected to the load lock chamber (not shown), and it is made possible by closing motion with the gate valve (not shown) between each load lock chamber. And the semi-conductor wafer W which is a processed object will be introduced into the processing room 4 of a plasma etching system 2 through each load lock chamber and a gate valve, or it will be constituted so that it can discharge from this, and the installation equipment 6 of the processed object by which it is characterized [of this invention] will be held in this processing room 4. The above-mentioned etching system 2 is an etching system of a RIE mold, the above-mentioned processing room 4 is formed of cylinder-like the up frame 8 and the lower frame 10, and these frames 8 and 10 are grounded electrically. While penetrating this and forming the gas installation way 12, this introductory way 12 is connected to the up side attachment wall of the up frame 8 in the source of raw gas (not shown). Moreover, the gas exhaust passage 14 connected to the vacuum pump which is not illustrated is penetrated and established in other lower side attachment walls of the up frame 8.

[0009] Right above the processing room 4, a field generator 16 like a permanent magnet is formed, and it is constituted so that a field horizontal to Wafer W may be impressed. Moreover, the installation base 18 of the installation equipment 6 of a processed object is constituted by the up susceptor 20 and the lower susceptor 22 which lay Wafer W directly. And between this up susceptor

20 and the lower susceptor 22, the heater 24 which consists of a ceramic heater is inserted, and it is constituted so that the temperature of Wafer W can be controlled. Wafer W is loaded to the top face of the up susceptor 20, and is held firmly here. In this case, in order to hold Wafer W firmly on the top face of the up susceptor 12, the electrostatic chuck unit (not shown) is prepared. The up susceptor 20 is attached in the lower susceptor 14 with the bolt 28 removable. Thus, the reason two susceptors 20 and 22 are made disengageable is because the up susceptor 20 can sometimes exchange only the up susceptor 20 by making into a maintenance free the lower susceptor 22 to which RF generator 30 was connected when contamination etc. is carried out.

[0010] The above-mentioned heater 24 is connected to the temperature controller 32 through the current regulator (SSR) 34. Near the contact section of a heater 24 and the up susceptor 20, the slot 38 which holds O ring 36 so that the periphery of a heater 24 may be surrounded is formed. And while the heat pipe 40 with which this was made to carry out field contact, and was filled up with the working fluids 42, such as Freon, inside is formed in the lower part of this lower susceptor 22, a cooling means 46, for example, a cooling jacket, by which liquid nitrogen 44 was held is formed in the lower limit of this heat pipe 40 as a refrigerant. The above-mentioned heat pipe 40 consists of a thermally conductive good ingredient, for example, aluminum etc., the upper part is fabricated by for example, hollow disc-like, and constitutes evaporator 40A, and interview contact of the top face is carried out at the inferior surface of tongue and the thermally conductive fitness of the lower susceptor 22. From the core of this disc-like evaporator 40A, the cylinder object of the hollow opened for free passage by the evaporator has extended towards down, and that lower limit section is inserted into the above-mentioned cooling jacket 46, and constitutes condensation section 40C.

[0011] The upper part and the side attachment wall of the lower susceptors 20 and 22 and the pars basilaris ossis occipitalis of evaporator 40A of a heat pipe 40, and the side attachment wall are completely covered with the insulating frame 26, and only the up front face of the up susceptor 20 is put to a processing ambient atmosphere. This insulating frame 26 is mainly constituted by flank insulation frame 26A of the shape of a cylinder which covers the side attachment wall of the above-mentioned each part material, and pars-basilaris-ossis-occipitalis insulation frame 26B which covers the pars basilaris ossis occipitalis of evaporator 40A. in this case, the ingredient 2 which is a low dielectric constant in order to insulate a RF as flank insulation frame 26A, and moreover controls thermal conductivity, for example, SiO, etc. -- the ingredient 2 which is a low dielectric constant in order to use and to insulate a RF as pars-basilaris-ossis-occipitalis insulation frame 26B, and moreover controls the thermal conductivity of the vertical direction, for example, SiO, etc. -- it uses. O ring 48 intervenes between the up susceptor 20 and flank insulation frame 26A, and the 1st gap 50 is formed among them. Moreover, if it is possible to make space 58 into a vacua like [in the case of the example of drawing 1], vacuum insulation of the cooling jacket 46 and the pars-basilaris-ossis-occipitalis insulation frame 26B is carried out, and although it is an indispensable condition, thermal conductivity does not necessarily have to make it small that it is a low dielectric constant in this case. Mirror polishing of the front face of the upper part and the periphery of the lower susceptors 20 and 22 and the medial surface of the side attachment wall of flank insulation frame 26A is carried out. Most inside of the 1st gap 50 is made by the vacuum, and has set up thermal resistance highly.

[0012] Moreover, since the actuation effectiveness of a heat pipe will fall if the heat insulation section is not formed between evaporator 40A of a heat pipe, and condensation section 40C, a pars-basilaris-ossis-occipitalis heat insulation frame is good to form with an insulator. Moreover, between evaporator 40A of a heat pipe, and pars-basilaris-ossis-occipitalis insulation frame 26B, and between this frame 26B and the cooling jacket 46, supporting material 51 and 56 is interposed, respectively.

[0013] In addition, although not illustrated, a pusher pin, a measuring instrument for control, etc. which push up Wafer W under the pars-basilaris-ossis-occipitalis insulation frame 26B are formed. The above-mentioned cooling jacket 46 is arranged just under pars-basilaris-ossis-occipitalis

insulation frame 26B, and liquid nitrogen 44 is held in the refrigerant hold section 60. The introductory pipe 64 and the discharge pipe 66 connect, and the introductory pipe 64 makes the tip of the discharge pipe 66 project more nearly up than the oil level of liquid nitrogen 44, and, as for the above-mentioned cooling jacket 46 and the source 62 of liquid nitrogen, discharges nitrogen gas while connecting with the pars basilaris ossis occipitalis of a jacket 20. It connects with the flow control valve (not shown) of the source 62 of liquid nitrogen, and from this controller 68, the output section of the main controller 68 turns a bulb setting signal to a flow control valve, and outputs it.
[0014] The wall of the pars basilaris ossis occipitalis of the cooling jacket 46 is made by the shape of porous one, is made as [occur / nucleate boiling], and can maintain the liquid nitrogen of the interior at -196 degrees C. The above-mentioned introductory pipe 64 for introducing liquid nitrogen into the refrigerant hold section 60 of the cooling jacket 46 is constituted by vacuum insulation tubing, and this vacuum insulation tubing is formed with a metal, and is grounded. The above-mentioned frame 8 is also grounded, it connects with the upper part and the lower susceptors 20 and 22, and the electrode with an opposite polarity impresses RF generator 30 among these.
[0015] Moreover, two or more insulating members 70 intervene between the cooling jacket 46 and pars-basilaris-ossis-occipitalis 10B of the lower frame 10, and form the 4th gap 72 among these. On the other hand, inside cylinder 10A of the lower frame 10 is prolonged upwards from pars-basilaris-ossis-occipitalis 10B of the lower frame 10, and it is protected so that these may not be put to a processing ambient atmosphere, while it surrounds the cooling jacket 46 and flank insulation frame 26A. O ring 26 is inserted between flank insulation frame 26A and inside cylinder 10B, and forms the 5th gap 78. Mirror polishing of the outside front face of the periphery of lower insulation frame 26A and the inside front face of inside cylinder 10B is carried out. O rings 36, 48, and 76 each are formed with Teflon resin or a metal seal. Moreover, the 5th gap 78 and the 1st gap 50 of the inside are opened for free passage with the free passage hole 77 formed in flank insulation frame 26A.
[0016] Two or more insulating members 70 which support the cooling jacket 46 are estranged mutually. Therefore, the 4th gap 72 and 5th gap 78 are opened for free passage mutually. Unless flank insulation frame 26A and the cooling jacket 46 contact inside cylinder 10B, the narrower desirable possible one of the 5th gap 78 is good. The flueing way 80 penetrates pars-basilaris-ossis-occipitalis 10B of the lower frame 10, is prepared, and it is constituted so that the inside of the 4th and 5th gaps 72 and 78 can be exhausted through this exhaust air way 80. The minute gap (not shown) is formed between the upper part and the lower susceptor 20, and 22, gas is supplied to this part from the automatic pressure controller (APC) 82, and thermal resistance is decreased. Although helium is used, as long as it does not make a member produce chemical corrosion but good thermal conductivity can be held, the heat transfer gas used here may be replaced with helium, for example, argon gas, xenon gas, nitrogen gas, a carbon dioxide, etc. are sufficient as it. The supply pressure of gaseous helium is controlled by APC82, and the pressure is set up in 0 - 760Torr.
[0017] As for thermal resistance, according to the experiment, in the relation between gas pressure and thermal resistance, gas pressure changes linearly between 0 - 30Torr(s). Gaseous helium can be supplied now to the gap between Wafer W and the up front face of the up susceptor 20 from APC90. The upper part, the lower susceptors 20 and 22 and the cooling jacket 46, and the lower frame 10 are formed with an aluminium alloy. The insulating frame 26 may be replaced with Teflon resin, and an alumina, AlN, silicon nitride, etc. may constitute it.
[0018] Moreover, in order that a temperature sensor 94 may detect wafer temperature, it is embedded in the upper limit section of the up susceptor 20, and the signal which shows the temperature detected by the sensor 94 is supplied to a temperature controller 32. The output terminal of this temperature controller 32 is connected to the current regulator (SSR) 34. It connects with the heater 24 and this SSR34 controls the current supplied to a heater 24. The output terminal of a temperature controller 32 is connected to the input terminal of the main controller 68. This temperature controller 32 operates as an auxiliary controller which operates so that the main controller 68 may be assisted.

[0019] On the other hand, as shown also in drawing 2 , a wick 96 like a wire gauze which a working fluid 42 is well absorbed [wick] like sponge all over the internal surface of the above-mentioned heat pipe 40, and makes capillarity produce is formed, for example, and it is constituted so that the working fluid 42 stored in condensation section 40C may be supplied to upper evaporator 40A through heat insulation section 40B by capillarity. Therefore, by making condensation section 40C of the lower part of a heat pipe 40 immersed in the liquid nitrogen 44 in the cooling jacket 46, the gas of the working fluid 42 which evaporated in evaporator 40A by the warm temperature from Wafer W side serves as a steamy style, flows down the inside of a heat pipe 40, is cooled by the cold energy of liquid nitrogen 44 in condensation section 40C, and is condensate-ized again. As a working fluid 42, when an actuation temperature requirement is -273--70 degree C, for example, helium, Ar, a krypton, N2, methane, etc. are used here, and when an actuation temperature requirement is -70-+200 degrees C, Freon, NH4, an acetone, a methanol, ethanol, a heptane, water, etc. are used.
[0020] Moreover, as a wick 96, a stainless steel wire gauze, foaming nickel, a metal wool, glass fiber, a carbon fiber, ceramic fiber, etc. can be used. For example, a thermally conductive good ingredient constitutes especially the actuation section 98,100 of the vertical edge which delivers and receives heat with the exterior, using aluminum, stainless steel, copper, etc. as an ingredient of this heat pipe 40. Furthermore, as it indicates drawing 3 (A) and drawing 3 (B) that surface thermal conductivity is raised and nucleate boiling is promoted, the nucleate-boiling promotion heating surface 104 is formed in the peripheral wall 102 of condensation section 40C which will contact the liquid nitrogen 44 of the cooling jacket 46, and directly. This nucleate-boiling promotion heating surface can take the large heat rate of flow, even if a temperature gradient is very small, and that formation approach is performed by carrying out the plasma metal spray of the powder, such as aluminum and duralumin, to the contact surface 102 with the liquid nitrogen which is the peripheral wall 102 of the condensation section 40 as shown in drawing 3 (A), and forming the melting particle 106 in it. In this case, it is desirable to set the path of a melting particle as 0.2-1.5mm, to set up the thickness of a thermal-spraying layer as 0.3-1.0mm, and to set up porosity to about 5 - 25%.
[0021] Moreover, as other formation approaches, as shown in drawing 3 (B), many fins 108 are formed in the liquid nitrogen contact surface 103 of a peripheral wall 102 by machining of engine-lathe processing etc., and you may make it form a cavity 110 in the interior by making the fin 108 which this fin 108 is made crooked mechanically and adjoins that point contact. As the formation approach of the nucleate-boiling promotion heating surface 104, it is not limited to the above-mentioned thing, but what kind of approaches, such as other approaches, for example, porous plating, the etching eating method, and the blasting forming method, may be adopted. Although the heat pipe itself has very good heat responsibility, by forming the nucleate-boiling promotion heating surface 102 as mentioned above, the heat responsibility can be enlarged further and it becomes possible to cool Wafer W to low temperature more.
[0022] Next, actuation of this example constituted as mentioned above is explained. The up frame 8 is grounded, by supplying RF power source to the susceptors 20 and 22 of the upper part and the lower part, a counterelectrode is constituted and the plasma etching system of a RIE method consists of this examples. Moreover, it is said wafer W and the location which counters, and a permanent magnet is rotated in the upper part of said processing room 4, and the magnetron etching system consists of forming a magnetic field parallel to the field near the wafer W. And where vacuum suction of the inside of the processing room 4 is carried out, etching gas is introduced, and the plasma by etching gas is generated between the above-mentioned counterelectrodes. Furthermore, by forming a level magnetic field near the wafer W, the flight direction of ion becomes perpendicular to a wafer W front face, and high etching of an anisotropy can be realized. In this case, vacuum suction of the inside of the processing room 4 is carried out through the gas exhaust passage 14, for example, it is maintained by the pressure of 10-2 - 10-3Torr extent.
[0023] Here, it faces performing the above-mentioned magnetron plasma etching, and the wafer W which is a processed object is cooled by cooling of the liquid nitrogen 44 of -196 degrees C of 46

cooling jackets through the heat pipe 40, the lower susceptor 22, and the up susceptor 20. Moreover, the wafer temperature at this time is detected by the temperature sensor 94, is inputted into the temperature pressure controller 82, and adjusts the amount of heating of a heater 24 that the set point, for example, -156 degrees C, should be maintained through a current regulator 34.

[0024] Although Wafer W is heated in response to radio-frequency energy from the plasma between etching processings, this warm temperature is transmitted to evaporator 40A of a heat pipe 40 through the up susceptor 20 and the lower susceptor 22. On the other hand, by capillarity, along with a wick 96, the liquefied working fluid 42 of condensation section 40C in this heat pipe 40 serves as a liquid flow, goes up, and results in evaporator 40A. It becomes the steamy style 112, in this evaporator 40A, in response to warm temperature, the liquefied working fluid 42 evaporates from the lower susceptor 22, and it evaporates, it flows down caudad and goes, and in condensation section 40C, in response to cold energy, it condenses again and is liquefied. Thus, cooling of the liquid nitrogen 44 in the cooling jacket 46 is supplied to upper part and lower susceptor 20 and 22, and Wafer W side by operation of the working fluid 42 which circulates through evaporation and condensation, and, finally Wafer W can be cooled to predetermined temperature.

[0025] Moreover, since the paries lateralis orbitae 102 which touches the liquid nitrogen 44 stored in the perimeter of condensation section 40C is constituted as the nucleate-boiling promotion heating surface 104 as shown in drawing 3 , even if its temperature gradients in this part are few, it can tell cooling of liquid nitrogen 44 efficiently to the working fluid 42 of a heat pipe 40, and it can make thermal resistance in this part small. Therefore, heat responsibility is good, and to the cooling about temperature which could not be realized by thermal resistance being too large, for example, -156 degrees C, since cooling of liquid nitrogen 44 is transmitted to Wafer W side using the heat pipe 40 with good heat transfer effectiveness and Wafer W was cooled, with equipment, Wafer W can be cooled conventionally. For example, conventionally, when -196-degree C liquid nitrogen was used as a cooling medium in equipment, even about -110 degrees C even of wafers could not cool W, but when the good heat pipe 40 of heat responsibility was used like this invention, it was able to cool to about -160 degrees C. Therefore, although the wiring section (aluminum) becomes detailed as the degree of integration of a semiconductor device is made detailed with 16M, 32M, and 64M, the plasma-etching processing corresponding to this is attained.

[0026] Since the heat responsibility of a heat pipe 40 is good as mentioned above, the radial-temperature-uniformity nature in the up flat surface of the up susceptor 20 can become good, can cool the inside of the field of Wafer W to homogeneity, and, moreover, can also improve temperature control nature, especially a dynamic property. or [moreover, / being emitted into atmospheric air by sending out the nitrogen gas in the cooling hold section 60 evaporated by cooling a working fluid 42 through the discharge pipe 66 to the source 62 of liquid nitrogen] -- or it is used, carrying out a reliquefaction.

[0027] Moreover, heat-conduction media, such as gaseous helium, are supplied also to the slot 38 formed in the upper part and the joint of the lower susceptors 20 and 22, and the chuck section of Wafer W, the pressure is controlled by APC 82 and 90, and a desired thermal resistance value is chosen. And since vacuum suction of the inside of the 4th gap 72 formed in the lower part of susceptors 20 and 22, flank insulation frame 26A, the 1st gap 50 formed between inside cylinder 10B, the 5th gap 78, and the cooling jacket 46 is carried out through the flueing way, thermal resistance is high. Moreover, evacuation also of the 2nd and 3rd gaps 52 and 58 is carried out similarly, and vacuum insulation is planned. Moreover, in order to change the thermal resistance between the up susceptor 20 and the lower susceptor 22, the matter (individual) which adjusted the bolting force of the bolt 28 which binds between these tight, or had specific thermal conductivity in these gaps is inserted, and you may make it change these contact conditions.

[0028] Moreover, the object which should carry out etching processing is SiO2. Although cooling temperature is changed corresponding to differing like a layer and polish recon, when the cooling power by the cooling jacket 46 is too strong, or in adjusting cooling temperature, it sets Wafer W as

predetermined cooling temperature by driving a heater 24 suitably. Furthermore, in order to make small thermal resistance between the lower susceptor 22 and a heat pipe 40, machining precision of these contact surfaces is made high, and may be made to perform gold plate of several micrometers or more etc. to the front face, or foils, such as an indium, are made to intervene among these planes of composition, and it may be made to make adhesion good.

[0029] Moreover, when controlling the temperature of Wafer W, the oil-level level of the liquid nitrogen 44 in the cooling jacket 46 is controlled, and you may make it change thermal flux by changing the immersion area of condensation section 40C by performing opening adjustment of the control valve 116 which forms the oil-level detection sensor (not shown) in the refrigerant hold section 60, and was prepared in the introductory pipe 64 based on the output value of this sensor. In addition, if it was in the above-mentioned example, from the up center section of the heat pipe 40, it turned caudad and passage was formed, but as it is not limited to this, for example, is shown in drawing 4 and drawing 5 , you may constitute. That is, while making small the diameter of the passage 120 which extends caudad in the equipment shown in drawing 4 , this passage 120 is located in the periphery section of circular evaporator 40A, and the installation tooth spaces 122, such as a measuring instrument, are formed near directly under [of evaporator 40A]. And the volume of condensation section 40C connected to the lower limit of the above-mentioned passage 120 is set up greatly. And a wick 96 is formed in the wall of the passage 120 which constitutes evaporator 40A, condensation section 40C, and heat insulation section 40B like the above, and the steamy style 112 out of evaporator 40A is made to flow down ****** in the above-mentioned passage 120.

[0030] Moreover, if it is in the equipment shown in drawing 5 , plurality 122 and 124, for example, two passage, is formed in the both ends of evaporator 40A, and the lower limit section of these passage 122 and 124 is connected by condensation section 40C. And a wick 96 is formed in each inside of one passage 122, evaporator 40A, and condensation section 40C, and it is made not to prepare a wick in the inside of the passage 124 of another side. According to this, since the liquid flow 126 of a working fluid 42 goes up the inside of the passage 122 in which the wick 96 was formed and another side and the steamy style 112 of a working fluid flow down the inside of the passage 124 of another side, a circulation path will be formed as a whole. Therefore, the force of the hard flow by the steamy style cannot act on the liquid flow 126 which goes up the inside of the passage 122 in which the wick 96 was formed, but the heat responsibility of a heat pipe can be raised further.

[0031] Moreover, bellows 130 can be connected to above-mentioned one passage 124 through a pipe 128, and the actuation temperature requirement of a working fluid 42 can be changed by making it expand and contract with the actuator which does not illustrate this, and changing the pressure in a heat pipe. In addition, although the case where the installation equipment of the processed object concerning this invention was applied to a plasma etching system was explained if it was in the above-mentioned example, of course, it can apply to minute sample observation equipments, such as equipment with the need of it not being limited to this, but processing thru/or observing a processed object in the state of low temperature, for example, an ashing device, a CVD system, prober equipment, ion implantation equipment, and SEM equipment, etc. Moreover, as a processed object, it is not limited to a wafer, and, of course, is not limited to liquid nitrogen as a cooling medium, either.

[0032]

[Effect of the Invention] As explained above, according to the installation equipment of the processed object of this invention, the following outstanding operation effectiveness can be demonstrated. Since the good heat pipe of heat responsibility was used, a processed object can be efficiently cooled to low temperature. Moreover, it not only can raise the radial-temperature-uniformity nature of a processed object for the above-mentioned reason, but it can raise temperature control nature.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

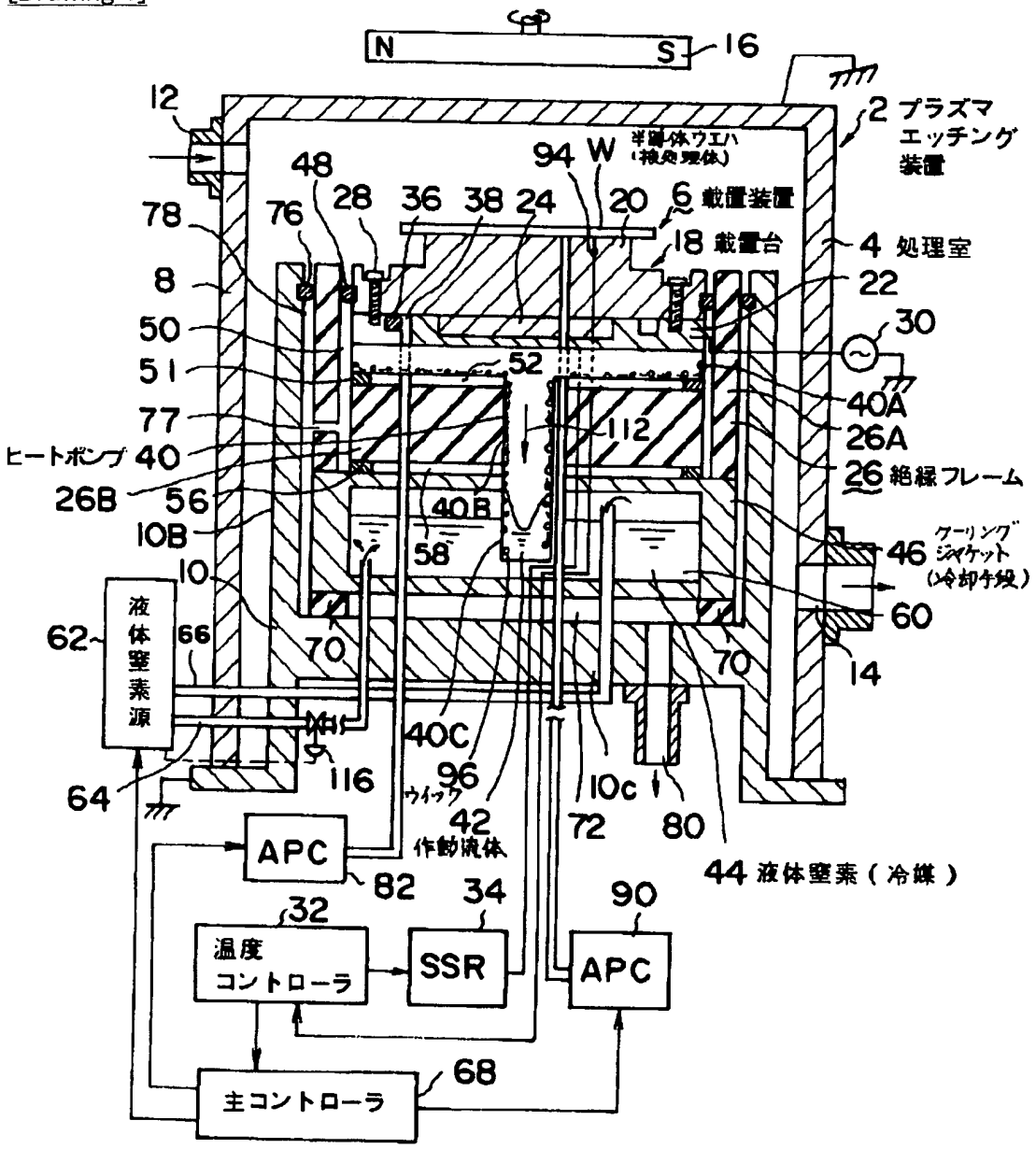
[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the plasma etching system which applied the installation equipment of the processed object of this invention.
[Drawing 2] It is the sectional view showing the installation equipment of the processed object in the plasma etching system shown in drawing 1 .
[Drawing 3] It is an explanatory view explaining how to form the nucleate-boiling promotion heating surface given to a heat pipe.
[Drawing 4] It is the sectional view showing other examples of this invention.
[Drawing 5] It is the sectional view showing the example of further others of this invention.
[Description of Notations]
2 Plasma Etching System
4 Processing Room
6 Installation Equipment of Processed Object
18 Installation Base
20 Up Susceptor
22 Lower Susceptor
26 Insulating Frame
30 RF Generator
40 Heat Pipe
40A Evaporator
40B Heat insulation section
40C Condensation section
42 Working Fluid
44 Liquid Nitrogen (Refrigerant)
46 Cooling Jacket (Cooling Means)
96 Wick
W Semi-conductor wafer (processed object)

[Translation done.]

* NOTICES *

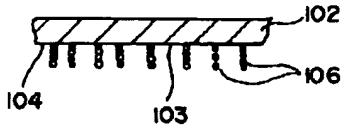
DRAWINGS

[Drawing 1]



[Drawing 3]

(A)



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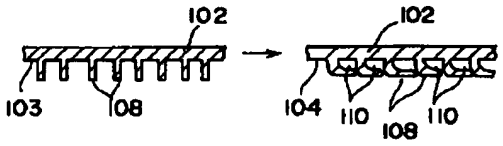
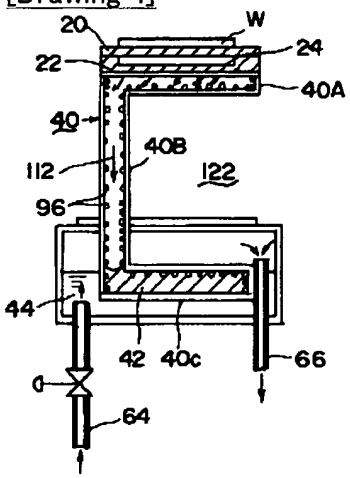
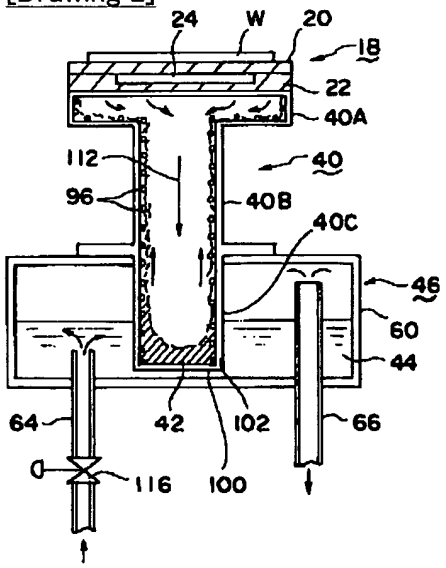


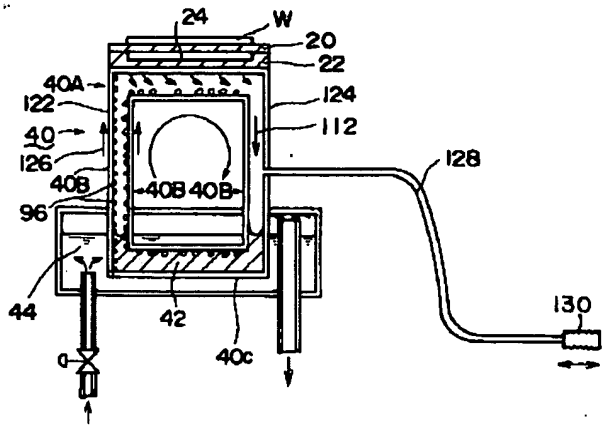
[Drawing 4]



[Drawing 2]



[Drawing 5]



[Translation done.]